

Marie-Pierre Ruas · Laurent Bouby · Vanessa Py ·  
Jean-Paul Cazes

## An 11th century A.D. burnt granary at La Gravette, south-western France: preliminary archaeobotanical results

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**Abstract** A thick layer of carbonised seeds was encountered in an 11th century A.D. room situated in the seigneurial part of the village of La Gravette. This paper presents the first results of charcoal and seed analyses which give information on the food products stored in the granary and on their arrangement there. *Triticum aestivum/durum/turgidum* was by far the most important stored crop, while *Avena* sp., then *Hordeum vulgare*, *Secale cereale*, *Triticum monococcum* and *Vitis vinifera* were secondary. Weeds were poorly represented. Charcoals were dominated by deciduous *Quercus* sp., and 11 additional wood taxa were recorded, including especially *Fagus sylvatica*, *Fraxinus* sp., Rosaceae, *Corylus avellana*, *Acer campestre* and *Ulmus* sp. According to the charcoal distribution, *Quercus* and *Fagus* were probably building materials while most of other taxa would have been used for basketry, wattling or joinery work. In the western part of the granary, naked wheat was stored in bulk. In the eastern part, various crops (at least naked wheat, barley, rye, oat and grape) were stored in small amounts, most of which were probably separated by light wooden structures. The cereal crops had largely been processed and cleaned. The stored products probably represent taxes paid to the lord who owned the granary.

**Keywords** Archaeobotany · Charcoal · Middle ages · Seeds · South-western France · Storage

### Introduction

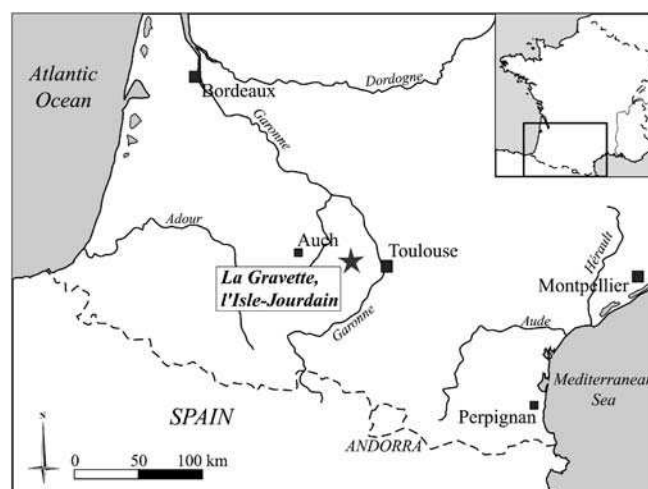
During the rescue excavations carried out at La Gravette (l'Isle-Jourdain, Gers), a huge layer of carbonised plant remains was discovered in a medieval building which was part of the seigneurial accommodation. Archaeobotanical work on various high medieval sites has already delivered substantial information about the economic plants in the Toulouse region (Ruas 1992, 1998). The analysis of a burnt granary, however, provides a special opportunity to investigate crop processing and crop storage practices. Such a study has recently been possible at 14th century Durfort, a more recent site located in a mountainous area, 60 km to the east of Toulouse (Ruas 2002). The archaeobotanical assemblage from La Gravette will provide information about a somewhat more ancient site, located in a plain area. One particular feature of interest is the

M.-P. Ruas (✉)  
CNRS, UTAH 5608,  
Maison de la Recherche,  
5 Allées A. Machado, 31058 Toulouse Cedex 09, France  
e-mail: ruas@univ-tlse2.fr

L. Bouby  
CNRS, CEPAM 6130,  
250 Rue A. Einstein, Sophia-Antipolis, 06560, Valbonne, France

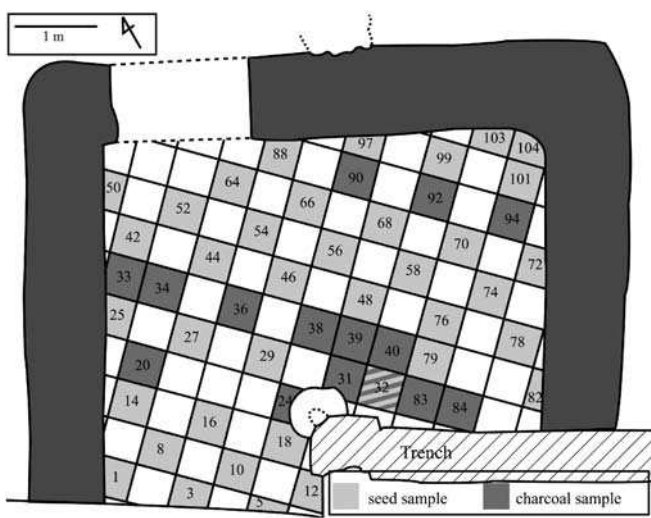
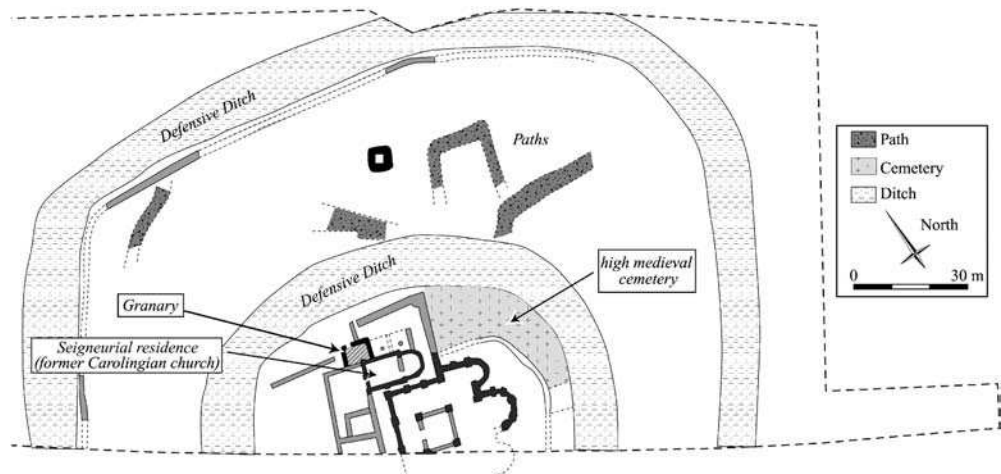
V. Py  
Université de Provence,  
LAMM MMSH,  
5 Rue du Château de l'Horloge, 13094 Aix-en-Provence, France

J.-P. Cazes  
CCS Patrimoine,  
UTAH 5608,  
47 Rue du Château d'eau, 11400 Castelnaudary, France

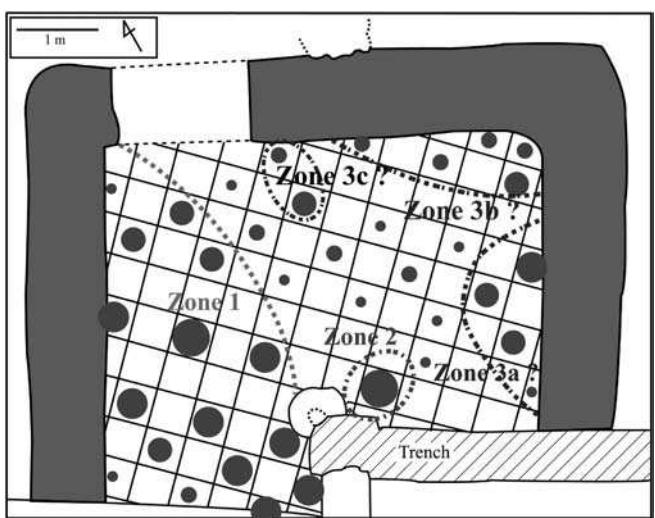


**Fig. 1** Location map of the site of La Gravette (l'Isle-Jourdain, Gers)

**Fig. 2** Plan of a part of the site of La Gravette during the Medieval period



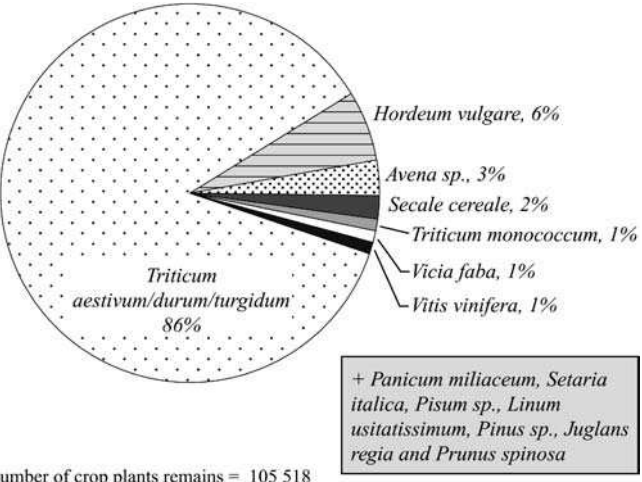
**Fig. 3** Location of the samples analysed for seed and charcoal remains in the granary of La Gravette



Volume of seed remains/litre

- more than 300 ml
- from 150 to 300 ml
- from 50 to 150 ml
- from 20 to 50 ml
- 0 to 20 ml

**Fig. 5** Density of seed remains (volume of plant remains/litre) in the samples from the granary of La Gravette and hypothetical zones of high density



number of crop plants remains = 105 518

**Fig. 4** General proportions of the most important food plants in the granary of La Gravette

opportunity to analyse stores that are supposed to have belonged to the local lord. The archaeobotanical work is still in progress but substantial information is already available about the stored products, as well as about the crop storage and crop processing practices.

The site of La Gravette (l'Isle-Jourdain, Gers) is set on the Gascony plain, some 150 m asl. It is located near the Save, a tributary of the river Garonne, roughly 35 km to the west of Toulouse and of the Garonne (Fig. 1). A village was established there during Roman times (1st century A.D.), along the main road going from Toulouse to Bordeaux and the Atlantic coast (Cazes 1995). It can be

**Table 1** Seed results: estimated number of remains per litre of sediment from the granary of La Gravette, L'Isle Jourdain

	Sample	1A	3	5	8A	10A	12	14A	16	18	25	27	29	32B	42	44	46	48	50	52
Cereals																				
<i>Avena sativa</i>	hulled grains	0	1	4	4	7	6	5	3	4	9	1	5	43	7	2	0	0	0	0
<i>Avena sativa</i>	lemma bases	4	3	15	29	33	18	65	52	25	21	33	25	172	5	7	0	11	0	2
<i>Avena</i> sp	naked grains	15	25	135	113	155	131	343	254	176	246	394	220	694	81	48	3	97	16	56
<i>Cerealia</i>	caryopses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hordeum vulgare</i>	caryopses	5	7	70	27	68	89	62	53	67	87	92	51	900	85	15	1	73	8	33
<i>Hordeum hexastichum</i>	hulled grains	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
<i>Hordeum tetrastichum</i>	hulled grains	0	0	0	0	5	1	2	1	2	0	1	2	114	0	1	0	2	0	0
<i>Hordeum vulgare</i>	lemmas	0	1	1	0	0	9	3	2	0	0	0	0	23	0	0	0	0	0	0
<i>Hordeum vulgare</i>	rachis segments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Panicum miliaceum</i>	caryopses	3	10	1	1	1	1	0	2	2	2	4	4	6	1	4	0	2	0	4
<i>Panicum miliaceum</i>	caryopses	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Secale cereale</i>	caryopses	1	2	10	10	15	13	9	19	10	20	48	28	694	40	13	0	3	2	35
<i>Setaria</i> cf. <i>italica</i>	caryopses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Setaria</i> cf. <i>italica</i>	caryopses	2	0	0	0	0	2	0	2	0	0	1	0	1	0	1	0	0	0	0
<i>Setaria</i> sp	caryopses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Triticum dicoccum/ spelta</i>	caryopses	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0
<i>Triticum monoccoccum</i>	caryopses	1	2	0	4	9	3	12	6	5	11	37	12	373	14	8	0	12	6	9
<i>Triticum monoccoccum</i>	spikelet forks	2	0	1	0	2	0	3	0	0	4	16	3	249	0	2	0	4	0	2
<i>Triticum aestivum/ durum/ turgidum</i>	caryopses	377	797	4000	2788	5578	4183	4100	5578	5000	5578	9100	6693	8700	3346	1321	56	335	294	1673
<i>Triticum, naked cf. tetraploid</i>	rachis internodes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulses																				
cf. <i>Pisum</i>	seeds	1	0	2	5	4	1	5	9	10	10	24	18	18	7	4	0	2	2	2
<i>Vicia faba</i>	seeds	0	0	0	0	1	0	1	0	0	3	4	2	25	2	2	2	7	2	1
Oil/Fibre Plant																				
<i>Linum</i> cf. <i>usitatissimum</i>	seeds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Fruits																				
<i>Juglans regia</i>	shell fg	0	0	0	1	0	0	0	0	0	2	0	0	1	0	2	0	0	0	0
<i>Pinus</i> sp	cone fg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunus</i> cf. <i>spinosa</i>	fruit-stones	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>Vitis vinifera</i>	pips	27	4	1	15	3	0	7	4	3	8	7	7	21	2	1	1	7	2	0
<i>Vitis vinifera</i>	pedicels	3	1	0	1	0	0	0	3	0	0	0	1	1	1	0	0	0	0	0
<i>Vitis vinifera</i>	bunch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Vitis vinifera</i>	stalk fg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Vitis vinifera</i>	berries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weeds																				
<i>Agrostemma githago</i>	seeds	3	9	14	13	35	31	36	35	28	36	97	26	130	15	9	0	8	0	11
<i>Avena fatua</i>	hulled grains	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0
<i>Avena fatua</i>	lemma bases	1	0	1	2	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0
cf. <i>Echinochloa crus-galli</i>	caryopses	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Echinochloa crus-galli</i>	caryopses	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Fabaceae	seeds	5	10	27	27	44	28	116	100	64	194	472	184	0	88	40	3	15	12	39
<i>Lathyrus</i> cf. <i>cicera</i>	caryopses	16	8	58	38	56	44	166	92	65	77	240	82	296	24	25	2	17	0	29
Poaceae	caryopses	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0
Parasitic Fungus																				
cf. <i>Claviceps</i> sp	sclerotia	0	0	1	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0
	Total of identified remains	468	881	4340	3080	6019	4561	4936	6215	5464	6308	10572	7363	12467	3718	1507	68	597	344	1897
Other types of remains																				
Insects	larva/adults	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
carbonized organic material	fragments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0

54	56A	58B	64	66B	68	70	72	74	76A	76B	78A	79A	82	88	97	99	101	103	104	total
0	1	0	1	15	1	0	7	1	0	0	0	0	2	4	3	0	2	2	0	140
2	6	1	1	12	4	2	55	27	3	3	55	0	3	6	9	8	5	7	6	735
33	192	61	16	161	48	48	3321	200	33	77	221	23	34	67	144	92	168	233	130	8504
0	0	0	0	0	0	0	48	47	0	0	0	11	14	0	0	0	0	0	0	120
25	130	123	28	233	59	74	846	389	25	104	571	24	80	88	189	164	378	287	194	5804
0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5
0	5	0	0	20	0	3	16	1	2	3	13	0	6	5	5	2	14	7	2	235
0	0	0	0	3	0	1	16	10	1	0	0	0	2	1	0	1	4	3	0	81
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6	7	4	4	0	2	4	5	3	2	2	5	2	2	0	7	6	2	1	1	113
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
18	4	15	15	147	0	6	243	208	3	8	212	1	28	53	34	46	119	92	50	2274
0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
0	0	6	0	0	0	1	0	0	3	3	1	0	0	0	1	0	0	1	1	26
0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
6	39	26	9	82	13	17	203	126	8	31	133	9	25	26	53	47	86	88	41	1592
0	11	5	1	40	6	9	106	66	1	8	63	0	13	11	18	14	1	51	14	726
558	307	502	131	837	136	215	3095	1673	98	512	1673	173	111	321	418	335	797	644	530	82563
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
3	2	2	0	0	0	0	8	3	0	0	1	1	0	0	0	0	0	1	0	145
0	13	18	0	4	6	4	34	12	3	5	8	3	2	2	9	3	4	4	5	191
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	8
0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	4
3	3	8	3	6	2	10	806	136	3	2	166	2	40	5	38	18	161	84	100	1716
0	0	1	0	0	0	1	256	36	0	0	22	0	3	1	2	7	2	27	17	386
0	0	0	0	0	0	0	43	7	0	0	10	0	0	1	0	0	0	0	6	67
0	0	0	0	0	0	1	39	5	0	0	5	0	0	0	3	1	0	6	1	61
6	7	5	6	27	0	4	37	29	2	6	31	2	5	14	11	13	15	22	12	790
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
25	8	25	10	22	6	8	168	74	4	23	83	5	16	12	21	24	7	38	19	2066
10	25	27	6	83	19	27	123	99	9	29	104	0	19	20	20	31	62	42	31	2121
0	1	0	2	0	0	0	2	2	3	2	0	1	2	0	0	1	0	1	0	20
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	8
695	762	829	233	1698	305	436	9478	3154	204	818	3378	259	408	637	986	813	1827	1644	1163	110532
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67

fg: fragments, sg: segments

seen from an important cemetery that during the 6th century A.D. a Frankish group was established in the village. The site underwent some changes during High Medieval times. First, a church was built and developed together with a cemetery, up to the beginning of the 12th century. The situation then changed as two surrounding defensive ditches were excavated. Ecclesiastical and funereal uses decreased, and the former Carolingian church was now converted to residential use, probably occupied by the lord (seigneur). The granary was located in the rich residential area, just against the northern wall of the ancient Carolingian church (Fig. 2), and comprised a room of 7.6×5.6 m. The building was probably covered with perishable materials and its walls were made of wood and mud. It was destroyed by fire during the second half of the 11th century. A radiocarbon date (Beta-191051: 920±40 B.P.), from carbonised seeds, is in agreement with the chronology based on stratigraphic and ceramic data. The 2  $\sigma$  calibrated result (95% probability) is A.D. 1020–1210 (Stuiver et al. 1998), with the highest probabilities around A.D. 1060, 1080 and 1150. The last probability should be rejected because at that time the village was totally deserted, which happened during the first half of the 12th century.

## Materials and methods

During excavations of the granary, a 5 cm thick layer of carbonised plant material was encountered. It regularly covered nearly all the floor of the room (ca 25 m<sup>2</sup>). It was visible to the naked eye that the layer was mainly composed of charred grain. A systematic sampling procedure was therefore carried out to analyse the spatial distribution of plant remains. A sample of ca 1 l was taken from every 50×50 cm square of the room. Samples were processed by simple water hand flotation and sieved on 2 and 0.5 mm meshes. Inorganic residues left after flotation were also systematically processed on 2 and 0.5 mm meshes, to test the flotation efficiency. This was useful because many small pulses, and sometimes also chaff remains, were recovered from the 2 mm residues.

### Carpology (seeds)

Up to now, from the 115 samples available, only 39 have been selected, distributed quite regularly over the whole room surface for preliminary analysis (Fig. 3). These samples were completely sorted and plant macrofossils identified using a binocular stereomicroscope, with comparison to a modern reference collection (UTAH, Toulouse) and with the aid of relevant identification literature. Small pulses and caryopses of wild Poaceae still need more detailed work on identification and are up to now only considered at the family level. Plant remains have been counted, except at the present time fragments of cereal grains and glumes. When there was enough material (more than 0.5 ml), the volume of each morphological type was measured as well. The volume of wild herbaceous plants was always insignificant. It has arbitrarily been estimated to 1 ml for each sample, and in most cases weeds are overrepresented. Graphics have been made to compare the spatial distribution of taxa. They are based on the volume of plant components estimated for samples of 1 l (proportionally estimated when samples were slightly more or less than this).

### Anthracology (charcoal)

Charcoal remains have been sorted only in the >2 mm fraction and their volume was measured for each sample. Charcoal identifications have been carried out only on 15 samples at the present time (Fig. 3). Only the larger fragments, roughly larger than 4 mm, were analysed because most of the small charcoals result from a secondary fragmentation subsequent to sampling. Charcoals were examined under a reflected light microscope and determined by comparing their anatomical structure with a modern collection of charred samples (MMSH, Aix-en-Provence) and with identification literature (Schweingruber 1990; Vernet 2001).

## Results

### Identified fruits and seeds

At the present time, 110,532 seed remains have been analysed; they allow the identification of 21 taxa, 15 useful plants and 6 weeds. Results presented in Table 1 are the numbers of plant remains proportionally evaluated for calibrated samples of 1 l. Crop plants are arranged according to their economic use, and wild plants in alphabetical order. For each taxon the types of retrieved plant remains are distinguished. Proportions of the main taxa are also presented in Fig. 4, according to their volume. *Triticum aestivum/durum/turgidum* (naked wheat) was largely the most abundant grain. *Triticum aestivum* (naked hexaploid wheat) and *T. durum* or *T. turgidum* (tetraploid wheats) cannot be distinguished from grains alone (Jacomet 1987; Maier 1996). We have therefore chosen to use the general term *Triticum aestivum/durum/turgidum* for naked wheat grains. One single rachis internode was recovered. Although it is badly preserved, morphological criteria would point to a tetraploid type (Jacomet 1987; Maier 1996). However, according to historical written sources, only bread wheat seems to have been grown in southern France at that time (Comet 1992). The naked wheat from La Gravette is therefore very likely to have been *T. aestivum* (bread wheat). According to their volumes, *Hordeum vulgare* (*tetrastichum* and *hexastichum* types), *Avena sativa*, *Secale cereale* and *Triticum monococcum* are, in decreasing order, cereals of secondary importance (from 6% to 1%). Hulled barley, oat and einkorn grains and also chaff were found. A few intact spikelets of *T. monococcum* and numerous spikelet forks were found. *Panicum miliaceum* and *Setaria italica* (millets) were found in negligible amounts. A few grains of *Triticum dicoccum* (emmer wheat) could also have been found but hard evidence is lacking.

Another useful plant of some importance in the granary is *Vitis vinifera*. The grape remains were principally composed of pips, but crushed berries, pedicels and other stalk fragments of the bunch were also found. A few seeds were found of pulses, *Vicia faba* (bean) and *Pisum* sp. (*sativum*?). Some of the *V. faba* seeds were damaged by *Bruchus rufimanus* (bean weevil), and a few *B. rufimanus* remains were found. Remains of another weevil (*Curculio* sp.) were found as well, some inside wheat grains, but most were just mixed with the grain. The list of possible



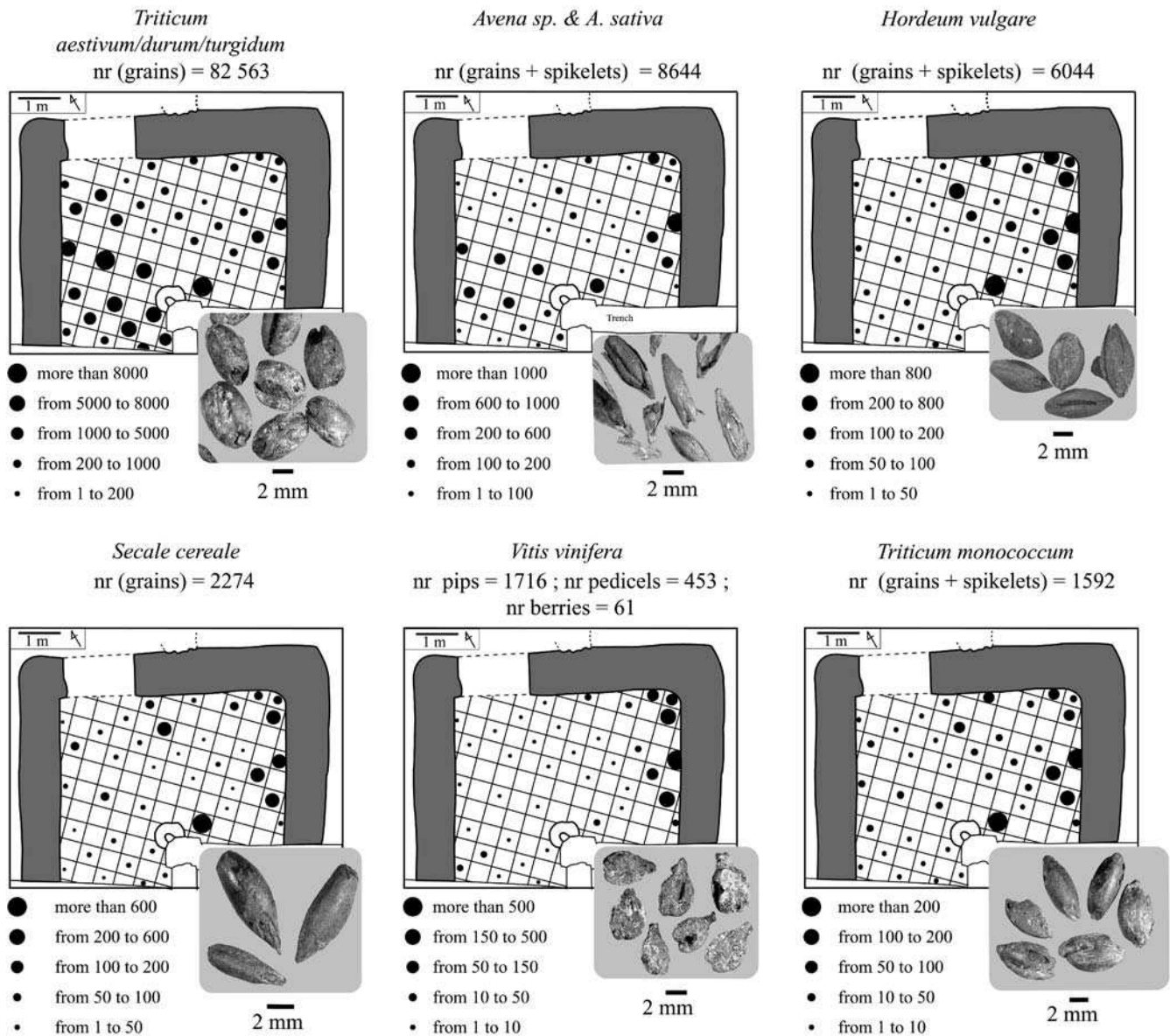


Fig. 6 Spatial distribution of the most important food plants in the granary of La Gravette (number of plant remains/litre)

useful plants ends with some rarer taxa: *Lathyrus* cf. *cicera*, *Linum usitatissimum*, *Pisum* sp., *Juglans regia*, *Pinus* sp. and *Prunus* cf. *spinosa*.

The amount of weed seeds is less than 1.5% of the total volume of seed remains. They consist of *Agrostemma githago*, *Avena fatua*, *Echinochloa crus-galli*, Fabaceae and Poaceae. The two latter taxa will need further identifications.

#### Spatial distribution of the crops

The number of seed remains is highly variable from one sample to another (with a density ranging from 68 to 12467 plant remains/l). The analysis of the variations of density shows a spatial pattern in the granary (Fig. 5).

Three main areas can be distinguished. A first zone of high density covers a wide area, of at least 8 m<sup>2</sup>, in the western part of the room, along a north-west/south-east axis. The density decreases from the centre to the edge of this area. To the east of Zone 1, a parallel strip of very low density of remains goes from the door in the northern corner in a south-eastern direction. At the end of this strip is located the second zone of high density (Zone 2), a very restricted area centred on the sample of highest density in the whole granary. A last wide zone of high density is located in the north-eastern part of the granary, but, unlike Zone 1, samples are of very irregular density within this last area, and it could actually be composed of different, partly mixed, heaps. Three hypothetical sub-zones can be distinguished. One would be located along the south-eastern wall (Zone 3a), one in the eastern corner (Zone

**Table 2** Charcoal results: absolute frequencies of identified taxa from the granary of La Gravette, L'Isle Jourdain

Area	1	2	2	1	1	3b	1	1	2	2	2	3b	3b	2	2	Total
Samples	36	31	40B	34	33	90	20	24	32A	39B	83B	94	92	38	84A	
<i>Quercus</i> sp. deciduous	66	40	62	38	29	56	138	64	69	55	46	114	58	60	44	939
<i>Fagus sylvatica</i>	9	4	6	5	18	0	10	33	4	1	8	1	0	2	1	102
<i>Corylus avellana</i>	0	1	17	0	0	1	1	3	0	12	0	0	0	2	0	37
<i>Ulmus</i> sp	0	2	2	3	0	5	1	0	6	0	3	3	0	2	1	28
<i>Acer campestre</i>	0	2	0	2	2	0	0	0	0	0	1	25	1	3	0	36
<i>Fraxinus</i> sp	0	0	35	0	0	0	0	0	4	0	2	0	0	1	7	49
Rosaceae-Prunoideae	0	0	1	2	0	8	0	0	7	1	6	0	4	4	6	39
Rosaceae-Pomoideae	0	0	1	0	0	3	0	0	0	2	2	1	0	0	0	9
<i>Quercus ilex/coccifera</i>	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	4
<i>Alnus</i> sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
<i>Betula</i> sp	0	0	0	0	0	0	0	0	1	0	4	5	0	0	2	12
<i>Salix</i> sp	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
Indeterminata	0	0	0	0	1	2	0	0	5	1	3	1	0	1	1	15
Total	75	50	125	50	50	75	150	100	100	75	75	150	63	75	63	1276
Total determined	75	50	125	50	49	73	150	100	95	74	72	149	63	74	62	1261

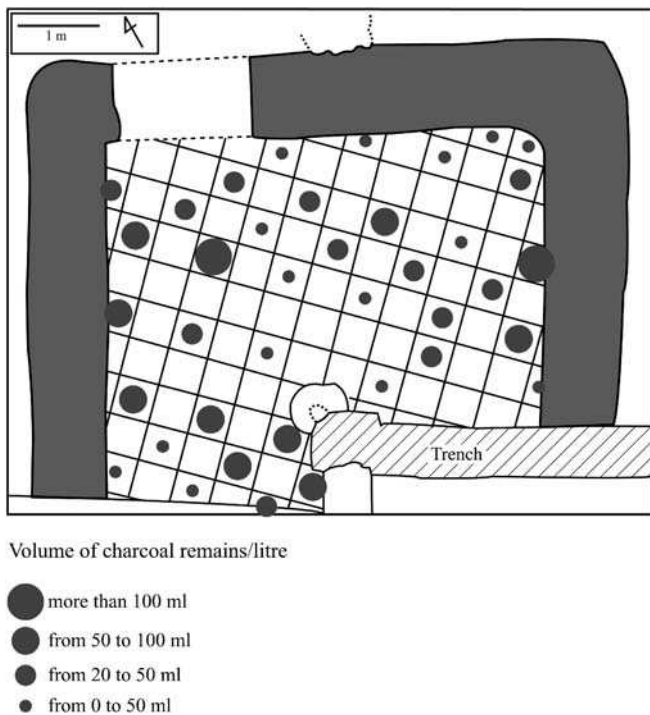
**Table 3** Charcoal results: percentages based on absolute counts of determined taxa (see Table 2) from the granary of La Gravette, L'Isle Jourdain

Zones	1	2	2	1	1	3b	1	1	2	2	2	3b	3b	2	2	Total
Samples	36	31	40B	34	33	90	20	24	32A	39B	83B	94	92	38	84A	
<i>Quercus</i> sp. deciduous	88.0	80.0	49.6	80.0	58.0	74.7	92.0	64.0	69.0	73.3	61.3	76.0	92.1	80.0	69.8	73.6
<i>Fagus sylvatica</i>	12.0	8.0	4.8	10.0	36.0	0.0	6.7	33.0	4.0	1.3	10.7	0.7	0.0	2.7	1.6	8.0
<i>Corylus avellana</i>	0.0	2.0	13.6	0.0	0.0	1.3	0.7	3.0	0.0	16.0	0.0	0.0	0.0	2.7	0.0	2.9
<i>Ulmus</i> sp	0.0	4.0	1.6	10.0	0.0	6.7	0.7	0.0	6.0	0.0	4.0	2.0	0.0	2.7	1.6	2.2
<i>Acer campestre</i>	0.0	4.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	1.3	16.7	1.6	4.0	0.0	2.8
<i>Fraxinus</i> sp	0.0	0.0	28.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	2.7	0.0	0.0	1.3	11.1	3.8
Rosaceae-Prunoideae	0.0	0.0	0.8	0.0	0.0	10.7	0.0	0.0	7.0	1.3	8.0	0.0	6.3	5.3	9.5	3.1
Rosaceae-Pomoideae	0.0	0.0	0.8	0.0	0.0	4.0	0.0	0.0	0.0	2.7	2.7	0.7	0.0	0.0	0.0	0.7
<i>Quercus ilex/coccifera</i>	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.3
<i>Alnus</i> sp	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.2
<i>Betula</i> sp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	5.3	3.3	0.0	0.0	3.2	0.9
<i>Salix</i> sp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Indeterminata	0.0	0.0	0.0	0.0	2.0	2.7	0.0	0.0	5.0	1.3	4.0	0.7	0.0	1.3	1.6	1.2

3b) and one last restricted zone could be situated close to the door (Zone 3c) (Fig. 5).

Zone 1 has a very homogeneous composition, largely dominated by naked wheat, the percentage of which is often over 90% of the crop remains (Fig. 6). There are insignificant proportions of other cultivated plants, of which the most important and most evenly distributed minor taxa in the bulk of *T. aestivum/durum/turgidum* are *Avena* sp. and *Pisum* sp. The situation is somewhat more confused in the other parts of the granary. In most of the samples, naked wheat is still the dominant taxon but other taxa play more important parts. The strong concentration of Zone 2, principally composed of naked wheat, includes as well consistent proportions of *Avena* sp., *Hordeum vulgare* and *Secale cereale*. In the north-eastern part of

the room the three hypothetical areas of high density cannot simply be connected to some particular species. However, the spatial pattern of density is clearly related to variations in the spatial distribution of taxa. There is a concentration of *Vitis* remains along the south-eastern wall (Zones 3a and b). Apart from grape, Zone 3a displays a great diversity. *Avena* is concentrated in sample 72, while the next south-western samples are particularly associated with *S. cereale*. Further towards the centre of the room, *Avena* and, to a lesser extent, *H. vulgare* are more abundant. In Zone 3b, beside grape, *S. cereale*, *T. monococcum* and especially *H. vulgare* have some importance. The distinction of a specific and restricted area of high density close to the door (Zone 3c) agrees with an increase in the proportion of rye in this sector.



**Fig. 7** Density of charcoal remains (volume of remains/litre) in the samples from the granary of La Gravette

### Results of charcoal analysis

Charcoal has been encountered in substantial amounts in all samples. Most significant volumes are observed to the north and to the south of Zone 1 on the one hand, in Zone 3a and to the south of Zone 3c on the other hand (Fig. 7). The analysis of 1276 charcoal fragments identified (Tables 1–2) at least 12 taxa (Fig. 8). *Quercus* sp. (deciduous oak) is largely dominant. According to present-day ecological conditions, we should probably assume that the species concerned is *Q. pubescens*. Other significant taxa (between 2% and 8%) are, in decreasing order, *Fagus sylvatica*, *Fraxinus* sp., Rosaceae Prunoideae, *Corylus avellana*, *Acer campestre* and *Ulmus* sp. Rarer taxa are *Betula* sp., Rosaceae Pomoideae, *Quercus ilex-coccifera*, *Salix* sp., and *Alnus* sp. Unfortunately, there are not yet representative charcoal results from all the areas of the granary. However, deciduous *Quercus* and *F. sylvatica*, the dominant taxa, seem to be rather evenly distributed throughout the room: they were probably used as building materials (for the frame, the roof or a possible floor). Secondary taxa were mainly located in the eastern part of the granary. Around Zone 2 a range of taxa such as *C. avellana*, *Fraxinus* sp., *Alnus* sp., *Acer campestre*, Rosaceae (Prunoideae and Pomoideae), and *Betula* sp. can reach rather high percentages in some samples. Moreover, *A. campestre*, *Betula* sp., Rosaceae Prunoideae and *Ulmus* sp. are well represented in a strip located to the south of Zone 3b. To the end of this strip, near Zone 3c, post-holes were observed during the excavations (Table 3).

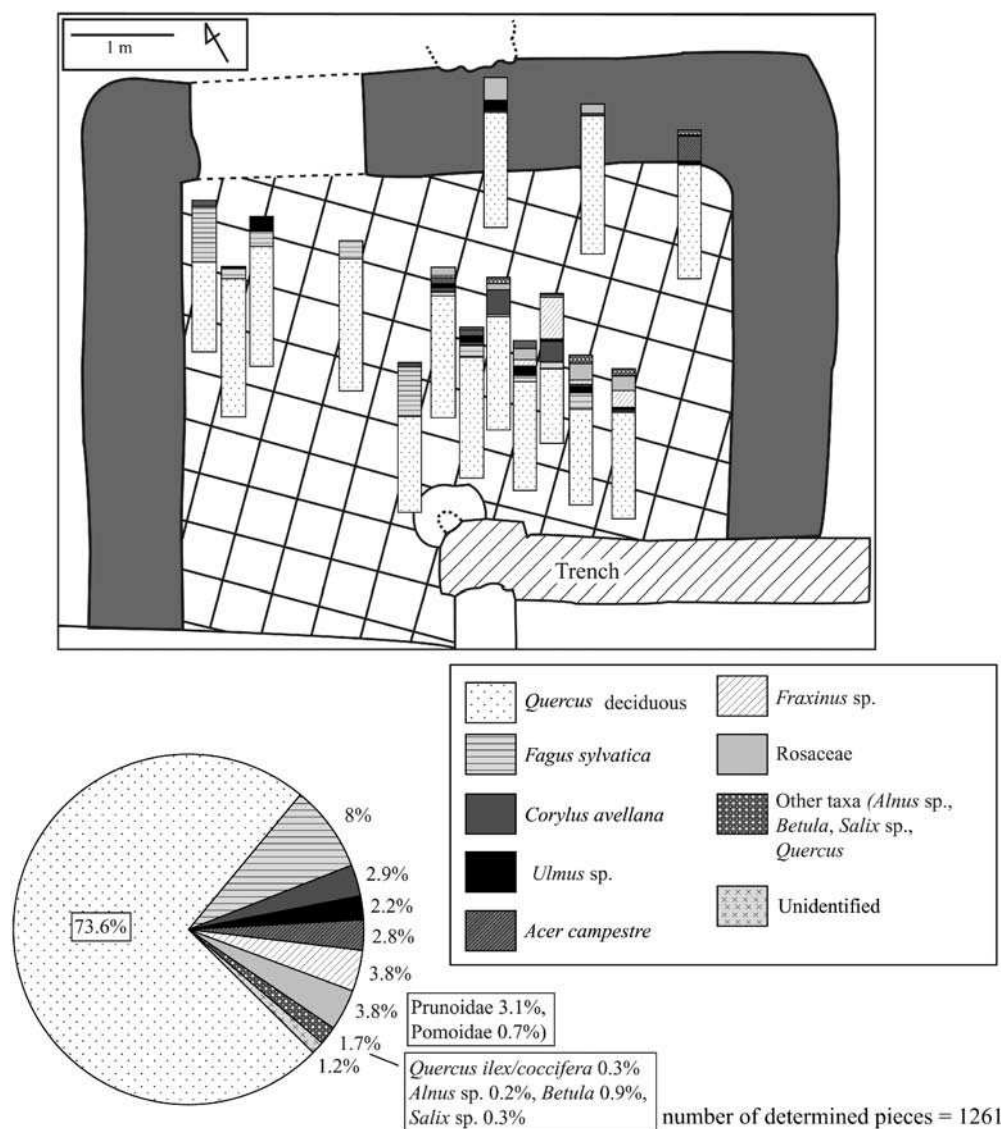
### Discussion

These preliminary archaeobotanical results provide information on the arrangement of the crops stored in the granary (Fig. 9). A large area in the western part of the room was dedicated to the storage of naked wheat. We have not found any evidence of possible containers (pottery storage vessels, bags, baskets, etc.) in which naked wheat could have been stored. One may therefore assume that *T. aestivum/durum/turgidum* was bulk stored in one or various heaps. Common oat and pea are very evenly distributed within the naked wheat store. They could therefore constitute contaminants of the field(s). In this part of room, the proportion of *Pisum* only amounts to 0.16%, and the proportion of hulled and naked grains of *Avena sativa* and *A. sp.* to 4% of the total. In comparison, the ratio of *Agrostemma* seeds, which are of the same size as prime grains of wheat (just as fruits/seeds of *Avena* or *Pisum*), reaches 0.7%. The proportions of *Pisum* and *Avena* seeds/fruits are therefore probably too low to suggest that they could have been sown on purpose to constitute deliberate mixtures. According to an ethno-archaeobotanical work carried out in Greece, the presence of minor crop contaminants mainly results from contamination of the seed corn (Jones and Halstead 1995). It is not therefore possible to simply assume that, in La Gravette, these contaminants result from crops previously grown in the field where naked wheat was cultivated last, and to infer from their presence the existence of a crop rotation system (rotation of wheat and oats for example), although both hypotheses should be considered (crop rotation and contamination of the seed corn). On the other hand, it is not possible to say if the other minor crops were already associated with *T. aestivum/durum/turgidum* in the fields or if they could have become mixed with it in the granary, from crops stored in other parts of the room or from remains of other crops previously stored in the same area.

The strip of low density of plant remains, which stretches from the door through the centre of the room, can logically be considered as a passage giving access to the different stored crops. In the eastern part of the granary various crops were stored, although naked wheat was still the major component. Pottery or textile containers which may have contained the crops were not identified either, but the charcoal analysis is giving evidence of the use of wooden structures to separate storage areas. In Zone 2, various crops (naked wheat, oat, barley and rye) were stored in a very restricted area. This crop diversity coincides with a diversity in wood taxa. Most of these trees and shrubs are well known for their uses as basketry, wattling or joinery (for example Rameau et al. 1989). We assume that the branches and twigs of these taxa were used in the construction of light wooden structures (wattling, basketry, shelves) in which various stocks were contained. This structure probably allowed a kind of piling up or vertical organisation of the stores. In Zone 3, where various little storages were also situated close to a more important naked wheat store, light wooden struc-



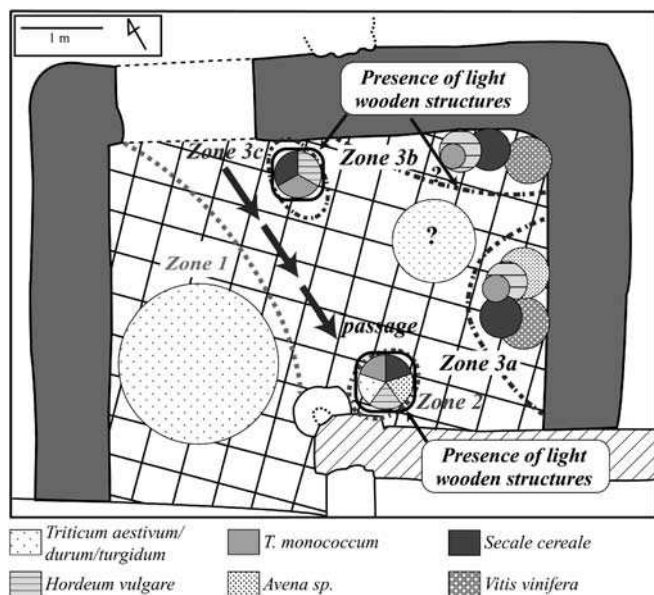
**Fig. 8** General proportions and distribution of wood taxa in the samples from the granary of La Gravette



tures were probably installed as well. The presence of postholes and the diversity of wood taxa in Zone 3c are in agreement with this hypothesis. A vertical organisation of the stores very probably also occurred in Zone 3. Unfortunately we cannot say at the present time how the various storages were installed. Was the naked wheat bulk stored in heaps, as in Zone 1, and the small stocks of other species put in baskets or on shelves? Were there various heaps of different crops separated by wooden barriers? Was naked wheat and the other species stored on different levels? Many hypotheses can be suggested. Likewise, our data is still insufficient to say if every important food plant was cultivated as separate monocrop or if some were grown mixed in the same fields. The distribution of *T. monococcum* in Zone 3 is for example significantly correlated to the one of *H. vulgare* ( $r=0.795$ ,  $p=0.001$ ). No great concentration of einkorn is detected in Zone 3. This glume wheat could therefore have been grown mixed with barley. It is not however fully satisfactory evidence. After destruction of the granary by fire, two species stored

side by side could probably have become somewhat mixed. Whether einkorn was grown as a monocrop or mixed with another cereal, according to several archaeobotanical studies carried out in southwestern France its frequent occurrence indicate that it was probably grown as a fodder crop during medieval times (Ruas 1998). However, at the present time, the granary of L'Isle Jourdain is the only medieval French site where this species is abundant (Ruas in press).

Various crops were abundant in particular areas of the granary and were therefore probably stored as pure crops or, at least, dominant crops in mixed assemblages (*Avena sp.*, *Hordeum vulgare*, *Secale cereale*, *Vitis vinifera*). Grapes are especially located along the south-eastern wall. Since grape pips are associated with crushed berries, pedicels and other stalk fragments, they give evidence of the storage of dried bunches of grapes or, more probably, of spent grape (marc), because isolated pips are much more abundant than berries. Marc could have been stored for example to be exploited as animal fodder (Magnier



**Fig. 9** Hypothetical reconstruction of the arrangement of the crops stored in the granary of La Gravette

1991), as fuel or as organic fertilizer. It could also have been used as an insulating material, which could explain its location along a wall, for example to prevent humidity oozing from the wall. Spent grape was also stored in one corner of the 14th century granary of Durfort (Ruas 2002).

In La Gravette, grapes could therefore be represented by a by-product of wine making. All the other crops show the opposite situation; they were found as largely processed products. They were put into storage at the usual stage of processing (Hillman 1981, 1984; Jones 1984), that is, as cleaned grains of naked wheat, rye and possibly horse bean, as hulled grains of oat and barley and as spikelets in the case of einkorn. However one may consider that the cleaning operations carried out before storage (such as winnowing, sieving and possibly hand-cleaning) were done with a particular care. In fact, as regards naked cereals, only a single rachis internode has been found in the whole granary. Weed seeds were rare in relation to cereal grains. We can moreover notice that all the weeds that were found have rather large seeds, which are difficult to eliminate completely from the grain. Such a careful cleaning of grains could be related to the social status of the owner of the granary, who is supposed to have been the local lord. The crops stored in the granary are likely to represent taxes, and one may assume that the seigneur was concerned to receive good quality cleaned products. This could also explain why naked wheat was the main crop in the granary. Of course, naked wheat was, together with barley, the most frequent crop during high and low medieval times in southern France, in particular on the Mediterranean plain (Bourin-Derruau 1987; Durand 1998, Ruas 1998). *Hordeum* was the dominant cereal in Languedoc during these periods, but bread wheat was considered a rich cereal which was sown in better soils

(Bourin-Derruau 1987). In medieval Gascony, bread wheat is often mentioned as tax, together with oat and a mixture of unspecified grains. Written sources of this region refer more exceptionally to taxes composed of rye, barley and millets (Mousnier 1997). It is of some interest to point to the fact that naked wheat, more probably bread wheat, and oats are the most frequent crops in this granary of high social rank.

## Conclusion

Although still in progress, the archaeobotanical study of the medieval granary of La Gravette recovered substantial information about the crops stored in the room and about their organization, especially thanks to a fine sampling procedure and to the analysis of seeds and charcoals together. Two large storage areas are indicated, separated by a passage. The first one (Zone 1) was dedicated to the storage of naked wheat, probably lying in heaps. In the second wide area (Zones 2 and 3) the situation is more confused. Small amounts of various crops were stored in this part of the granary. This crop diversity goes hand in hand with a diversity of wood taxa, as shown by charcoal analysis. This is regarded as evidence for the use of light wooden structures which kept the stored crops separate, and probably, at least in some cases, in order to allow some kind of stacking, or of vertical organisation, of the stores. It is already known that there were concentrations of *Triticum aestivum/durum/turgidum*, *Avena* sp., *Hordeum vulgare*, *Secale cereale* and *Vitis vinifera* in various places. However, it is necessary to study more samples in order to determine which crops were stored where in the granary, and which crops could have been grown in pure stands and which ones could have been grown as mixed crops in the fields. It will be of special interest to look for possible evidence of growing barley and einkorn in a mixture. This archaeological find reveals an aspect of the local agriculture: a diversity of crops which should be compared to the mixed farming system suggested by texts (Mousnier 1997).

Crop contamination by weeds is very low, which, together with the dominance of naked wheat, is thought to be related to the fact that the granary was part of the seigneurial accommodation. The lord would have asked for grain of high quality and purity, mainly composed of bread wheat, for the taxes he was being paid. Despite the low contamination by weeds, we expect that the forthcoming identification of the wild Fabaceae and Poaceae will provide ecological information about the fields in which the crops were grown and about the agricultural practices.

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